# The Contribution of Soiled Surfaces Within Feather Picking Machines to *Campylobacter* Counts on Broiler Carcasses[1]

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**Primary Audience:** Processing Plant Personnel, Quality Assurance Personnel, Researchers

## SUMMARY

**Numbers of *Campylobacter* detected on broiler carcasses decrease due to scalding but rebound during defeathering. Earlier research indicated that escape of gut contents during defeathering is an important contributor to the increase in *Campylobacter* numbers, whereas aerosols created by feather picking machines are not. The objective of this study was to determine if contact with surfaces in naturally contaminated commercial feather picking machines contributes to the increased counts of *Campylobacter* on broiler carcasses. Fully processed chilled carcasses with low numbers of *Campylobacter* were used as a platform to measure numbers after picking. Chilled carcasses were hung on shackles and allowed to proceed through 3 empty feather picking machines in a commercial processing plant that had been previously soiled by about 20,000 broilers. In 4 of 5 replications, although *Campylobacter* numbers increased on plant run control birds during defeathering, no increase in *Campylobacter* numbers was noted on chilled carcasses due to passage through the pickers. In one replication, however, a significant increase was observed. It is possible for contact with soiled surfaces within feather picking machines to increase *Campylobacter* numbers detected on broiler carcasses. However, overall these data suggest that naturally contaminated surfaces of feather picking machines are not a primary cause of the reported increase in *Campylobacter* numbers during defeathering.**

**Key words: broiler, *Campylobacter*, defeathering, feather picking, surface contamination**

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## DESCRIPTION OF PROBLEM

*Campylobacter*, a human pathogen associated with poultry and poultry meat, is one of the primary pathogens of concern in poultry processing. The main source of *Campylobacter* to the processing plant is live birds [1]. Relatively high numbers of *Campylobacter* have been recovered from feathers and skin of broiler carcasses as well as from within their digestive tracts [2]. Whole carcass rinse samples of prescald feathered carcasses have resulted in counts of *Campylobacter* close to 5.0 $\log_{10}$ cfu/mL [3]. Numbers of *Campylobacter* detected by whole carcass rinse are reduced by about 3.0 $\log_{10}$ cfu/mL due to commercial

[1]Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the US Department of Agriculture.

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scalding. However, subsequent passage through automated defeathering machines used in commercial poultry operations increases the number of *Campylobacter* recovered from carcasses significantly. *Campylobacter* counts can increase by up to 2.0 $\log_{10}$ cfu/mL or about 100-fold during defeathering [3]. Similar results have been reported when carcasses were sampled by skin surface swabs or sponge methods [4, 5]. This increase in *Campylobacter* numbers is problematic because carcasses carry more *Campylobacter* into the rest of processing and make it more difficult to get the lowest possible levels on postchill carcasses. Therefore, research has been focused on understanding the phenomenon and developing potential interventions.

Because scalding lowers *Campylobacter* counts, an intuitive approach to lowering the numbers on carcasses leaving the picker is to pass them through another scald step. This approach was examined in our laboratory but was not found to be particularly effective under the conditions tested [6]. Unsuccessful attempts at intervention serve to underscore the importance of studying *Campylobacter* ecology at this important stage of broiler processing so the problem can be approached in the most effective way.

*Campylobacter* is present in high numbers in the feces and gut contents of broilers from a positive flock. Gut contents can be forced out of the cloaca due to the action of picker fingers pressing on the abdomen. This has been shown to be an important contributor to the increase in *Campylobacter* numbers associated with defeathering [5].

Air in the feather picking area has been shown to be contaminated with high numbers of bacteria relative to other areas in the processing plant. Specifically, airborne *Campylobacter* has been detected in dusty areas of processing [7, 8]. However, when tested experimentally, exposure to the moist air near operating commercial feather picking machines did not lead to a significant increase in numbers of *Campylobacter* associated with broiler carcasses [9].

Surfaces within commercial feather picking machines become soiled as carcasses move through. If these carcasses are from a *Campylobacter*-positive flock the soil can be expected to contain *Campylobacter*. It is possible that by simple contact, surfaces within the machine may transfer such contamination to subsequent carcasses. The objectives of the current study were to examine the possibility that surfaces within soiled commercial feather picking machines can contribute to cross-contamination and increase the numbers of *Campylobacter* associated with broiler carcasses during defeathering.

## MATERIALS AND METHODS

### *Experimental Design and Overview*

Fully processed chilled broiler carcasses with low numbers of *Campylobacter* were used as platforms to examine the transfer of bacteria from surfaces within picking machines to carcasses. In each replication, 10 chilled carcasses were exposed to picker surfaces, and 10 remained unexposed as controls. To confirm the expected increase in *Campylobacter* numbers on carcasses as they were defeathered, 10 normal plant run carcasses were collected from the shackle line between the scalder and pickers and another 10 after defeathering. *Campylobacter* was enumerated on all carcasses. Five replications were conducted; therefore, the overall sample number was 50 for each treatment.

### *Samples*

This study was conducted in a commercial broiler processing plant with cooperation from a poultry industry partner. On each of 5 replicate sample trips, 20 carcasses were collected from the chill tank exit, placed individually into clean plastic bags that were placed into closed containers and then carried to the scald/pick area of the same plant. Ten carcasses were removed from the shackle line between the last scald tank and the first picker, and an additional 10 were removed from the shackle line immediately after defeathering before entering a rinse cabinet. All carcasses removed from the shackle line were individually bagged in clean plastic bags and placed into closed containers.

Plant employees hanging live chickens on the shackle line went on break after approximately 20,000 carcasses had passed through

TABLE 1. Mean $\log_{10}$ colony-forming units of *Campylobacter* (±95% confidence interval) detected on broiler carcasses collected from a commercial processing plant

| Replication | Prepick[A] | Postpick[B] | Postchill[C] | Postchill repicked[D] |
|---|---|---|---|---|
| 1 | 2.3[b] ± 0.5 (7)[E] | 3.7[a] ± 0.4 (10) | 2.3[b] ± 0.4 (10) | 2.2[b] ± 0.5 (9) |
| 2 | 2.3[b] ± 0.5 (9) | 3.4[a] ± 0.4 (10) | 1.8[b] ± 0.4 (10) | 1.4[b] ± 0.5 (9) |
| 3 | 1.5[b] ± 0.6 (6) | 3.8[a] ± 0.4 (10) | 2.1[b] ± 0.4 (10) | 2.4[b] ± 0.4 (10) |
| 4 | 2.1[b] ± 0.4 (10) | 4.6[a] ± 0.4 (10) | 1.4[b] ± 0.6 (5) | 3.6[a] ± 0.4 (10) |
| 5 | 1.9[b] ± 0.4 (10) | 4.5[a] ± 0.5 (10) | 1.7[b] ± 0.5 (9) | 2.5[b] ± 0.4 (10) |
| Mean | 2.1 ± 0.3 | 4.0 ± 0.2 | 1.9 ± 0.2 | 2.4 ± 0.2 |

[a,b]Means within rows (replication) with different superscripts are significantly different ($P < 0.05$) by Tukey's honest significant difference.
[A]Collected from the shackle line prior to defeathering.
[B]Collected from the shackle line after defeathering.
[C]Collected from the chill tank exit.
[D]Carcasses from chill tank exit that were then passed through a soiled picking machine.
[E]Number positive out of 10 carcasses within each replication.

the pickers. This left an empty shackle line, which continued to run through 3 operating feather-picking machines. Within 15 min of collection from the chill tank, 10 chilled carcasses were removed from plastic bags one at a time and were hung firmly by the legs in moving shackles immediately before the first feather-picking machine. After passing through all 3 feather-picking machines, each chilled repicked carcass was removed from the shackle line before entering a spray rinse cabinet and placed into a new clean plastic bag. All carcasses (repicked, control, plant run prepick, plant run defeathered) were sealed in their respective plastic bags with plastic wire ties, covered with ice, and transported to the laboratory for analysis.

### *Campylobacter Culture*

Within 1 h all feathered and defeathered carcasses were removed from ice and subjected to a low volume whole carcass rinse procedure [10]. Carcasses were rinsed by adding PBS (500 mL for feathered carcasses, 100 mL for defeathered carcasses) to each bag and shaking with an automated carcass-shaking machine for 60 s [11]. Rinses were aseptically collected from all carcasses, and serial dilutions were prepared in PBS. *Campylobacter* culture was conducted by direct plating onto the surface of Campy-cefex agar [12], which was then incubated for 48 h in a microaerophilic atmosphere consisting of 5% $O_2$, 10% $CO_2$, and the balance as $N_2$ [13]. Colonies with the characteristic appearance of *Campylobacter* were counted. Each colony type from every sample was confirmed as *Campylobacter* by observation of cellular morphology and motility on a wet mount using phase-contrast microscopy. Each colony type was further confirmed by a positive reaction from a serological latex agglutination test kit [14].

### *Data Analysis*

All *Campylobacter* counts were transformed to $\log_{10}$ colony-forming units per milliliter for analysis. An ANOVA was conducted, and Tukey's honest significant difference test was used to separate means within replications.

## RESULTS AND DISCUSSION

Numbers of *Campylobacter* detected in whole carcass rinses are shown in Table 1. In every replication, *Campylobacter* numbers on plant run carcasses were significantly higher after defeathering than before. This increase was expected because it has been reported before and is repeatable regardless of sampling method (whole carcass rinse or skin surface swab) [3, 4, 5]. These data serve to confirm that defeathering caused an increase in *Campylobacter* counts under the conditions of flock, plant, and processing day used in this experiment.

Also as expected, in each replication *Campylobacter* numbers recovered from chilled carcasses were much lower than those from carcasses immediately following defeathering. These data agree with earlier reports that modern broiler processing proce-

dures lower the numbers of human pathogens present on postchill carcasses [3, 4, 15, 16]. It is interesting to note, however, that *Campylobacter* numbers on postchill carcasses were not different than those detected on carcasses collected between scalding and picking. If the increase in *Campylobacter* numbers associated with defeathering could be decreased or eliminated, perhaps fully processed carcasses could be produced with even lower numbers of *Campylobacter*. To best approach the problem with a suitable intervention strategy, it is important to understand why increases in *Campylobacter* numbers occur during picking.

Fully processed chilled broiler carcasses are not necessarily equivalent to feathered carcasses, and they may not pick up *Campylobacter* from surfaces in the same way. However, carcasses in the current study were observed to make good contact with all picker fingers and other surfaces, which suggested they are reasonable sampling devices for use in operating feather-picking machines. In 4 out of 5 replications there was no increase in *Campylobacter* numbers on chilled carcasses due to passage through 3 soiled feather-picking machines. In only one replication (the fourth) was there a significant increase in the numbers of *Campylobacter* per ml carcass rinse. Replication 4 also had the highest plant run postpick numbers of *Campylobacter* detected throughout the study and the lowest postchill numbers. It is likely that the picker was more soiled in this replication than in the others and that the lower numbers on chilled carcasses made it possible to detect the increase during picking.

Because the fourth replication was different from the others and a replication effect was noted in the statistical analysis, the data are presented by replication rather than as a simple mean at each sample site. Although passing fully processed broilers through soiled feather-picking machines does not usually cause a significant increase in the numbers of *Campylobacter* detected, it is possible. Therefore, soiled feather-picking machines might have been able to transfer *Campylobacter* to carcasses that had low numbers to start with. However, it is not likely such an increase would be important relative to the numbers of *Campylobacter* routinely detected on the surface of carcasses before defeathering [2].

This was the third in a series of studies designed to help understand the increase in *Campylobacter* numbers during feather picking. These studies have concentrated on leakage of gut contents, contaminated air, and soiled surfaces as possible contributors to the observed increase. When taken in context with earlier studies conducted in our laboratory, soiled surface contamination did not appear to be the most important contributor to the increase in *Campylobacter* on carcasses during defeathering. Only leakage of gut contents has been consistent in its ability to cause *Campylobacter* increases of the order of magnitude observed in commercial settings [5]. Although soiled surfaces may be an infrequent transfer point, their importance pales compared with the consistent 2.0 $\log_{10}$ colony-forming units per milliliter of carcass rinse increase that has been demonstrated due to leakage of highly contaminated feces from the cloaca during defeathering [5]. To effectively counter the increase in *Campylobacter* numbers during feather removal, gut content leakage must be addressed. If escape of viable *Campylobacter* from the cloaca can be eliminated, transfer by surface contamination, which could originate from skin and feathers, may become more important. At any rate, controlling *Campylobacter* numbers on carcasses during defeathering has the potential to allow production of a safer product for consumers with lower numbers of this important human pathogen.

## CONCLUSIONS AND APPLICATIONS

1. It is possible for soiled surfaces within feather-picking machines to transfer *Campylobacter* and cause an increase in numbers associated with carcasses.
2. Surface contamination is not responsible for most of the increase in broiler carcass *Campylobacter* numbers observed during defeathering.

3. Escape of gut contents during defeathering must be addressed to lessen the increase in *Campylobacter* numbers associated with traditional feather removal.

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